What is claimed is:

1. A process for forming a nanoporous dielectric coating on a substrate which comprises:

(a) forming a substantially uniform alkoxysilane gel composition on a surface of a substrate, which alkoxysilane gel composition comprises a combination of at least one alkoxysilane, an organic solvent composition, water, and an optional base catalyst;

(b) heating the substrate for a sufficient time and at a sufficient temperature in an organic solvent vapor atmosphere to thereby condense the gel composition; and then

(c) curing the gel composition to form a nanoporous dielectric coating on the substrate.

2. The process of claim 1 wherein the organic solvent vapor atmosphere contains a relatively low volatility organic solvent which has a boiling point of about 175 °C or higher.

3. The process of claim 2 wherein the organic solvent vapor atmosphere contains a relatively low volatility organic solvent is selected from the group consisting of di(ethylene)glycol monomethyl ether, tri(ethylene)glycol monomethyl ether, tetra(ethylene)glycol monomethyl ether; di(propylene)glycol monomethyl ether, tri(propylene)glycol monomethyl ether, ethylene glycol, 1,4-butylene glycol, 1,5-pentanediol, 1,2,4-butanetriol, 1,2,3-butanetriol, 2-methyl-propanetriol, 2-(hydroxymethyl)-1,3-propanediol, ~~1,4,1,4-butanediol~~ 1,4-butanediol, 2-methyl-1,3-propanediol, tetraethylene glycol, triethylene glycol monomethyl ether, glycerol, di(ethylene)glycol, tri(ethylene)glycol, tetra(ethylene)glycol, penta(ethylene)glycol, di(propylene)glycol, hexa(ethylene)glycol and mixtures thereof.

4. The process of claim 1 wherein the organic solvent composition of step (a) comprises the same organic solvent as in the organic solvent vapor atmosphere of step (b).

5. The process of claim 1 wherein the solvent vapor atmosphere contains a relatively low volatility organic solvent which is present in the atmosphere in an amount of from about 50 to about 99.9 percent saturation.

6. The process of claim 1 wherein the optional base catalyst is present in the alkoxysilane gel composition.

7. The process of claim 1 wherein the alkoxysilane gel composition is formed by exposing the alkoxysilane to the water in the form of water vapor.

8. The process of claim 1 wherein the alkoxysilane gel composition is formed by exposing the alkoxysilane to the base catalyst in the form of base vapor.

9. The process of claim 1 wherein the alkoxysilane gel composition is formed by exposing the alkoxysilane both to water in the form of water vapor and to the base catalyst in the form of base vapor.

10. The process of claim 1 wherein the alkoxysilane gel composition is formed by depositing the alkoxysilane and the organic solvent composition onto the substrate in the form of a stream.

11. The process of claim 1 wherein the alkoxysilane gel composition is formed by depositing the alkoxysilane, the organic solvent composition, and the water onto the substrate in the form of a combined stream.

12. The process of claim 1 wherein the alkoxysilane gel composition is formed by depositing the alkoxysilane, the organic solvent composition, and the base catalyst onto the substrate in the form of a combined stream.

13. The process of claim 1 wherein the alkoxysilane gel composition is formed by depositing the alkoxysilane, the organic solvent composition, the water, and the base catalyst onto the substrate in the form of a combined stream.

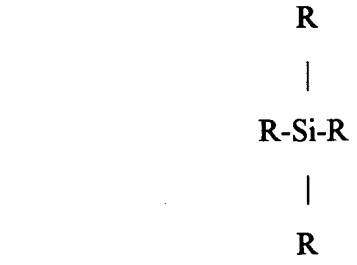
14. The process of claim 1 wherein the organic solvent composition of step (a) comprises a relatively high volatility solvent and a relatively low volatility solvent.

15. The process of claim 14 wherein the relatively high volatility solvent has a boiling point of about 120 °C or less and the relatively low volatility solvent has a boiling point of about 175 °C or more.

16. The process of claim 14 wherein the relatively high volatility solvent comprises one or more components selected form the group consisting of methanol, ethanol, n-propanol, isopropanol, n-butanol and mixtures thereof and wherein the relatively low volatility solvent composition comprises an alcohol or a polyol.

17. The process of claim 1 wherein the base catalyst is selected from the group consisting of ammonia, primary alkyl amines, secondary alkyl amines, tertiary alkyl amines, aryl amines, alcohol amines and mixtures thereof.

18. The process of claim 1 wherein the alkoxysilane has the formula:



wherein at least 2 of the R groups are independently C_1 to C_4 alkoxy groups and the balance, if any, are independently selected from the group consisting of hydrogen, alkyl, phenyl, halogen, substituted phenyl.

19. The process of claim 18 wherein each R is methoxy, ethoxy or propoxy.

20. The process of claim 1 wherein the alkoxysilane composition comprises at least one organic solvent selected from the group consisting of methanol, ethanol, n-propanol, isopropanol, n-butanol, ethylene glycol, 1,4-butylene glycol, 1,5-pentanediol, 1,2,4-butanetriol, 1,2,3-butanetriol, 2-methyl-propanetriol, 2-(hydroxymethyl)-1,3-propanediol, 1,4,1,4-butanediol, 2-methyl-1,3-propanediol, tetraethylene glycol, triethylene glycol monomethyl ether, glycerol, and mixtures thereof.

21. The process of claim 1 wherein the substrate comprises silicon or gallium arsenide.

22. The process of claim 1 wherein the substrate comprises at least one semiconductor material.

23. The process of claim 21 wherein the semiconductor material is selected from the group consisting of gallium arsenide, silicon, and compositions containing silicon such as crystalline silicon, polysilicon, amorphous silicon, epitaxial silicon, and silicon dioxide, and mixtures thereof.

24. The process of claim 1 wherein the substrate has a pattern of lines on its surface.

25. The process of claim 24 wherein the lines comprise a metal, an oxide, a nitride or an oxynitride.

26. The process of claim 1 wherein the gel composition is cured by heating.

27. The process of claim 1 wherein the nanoporous dielectric coating has a dielectric constant of from about 1.1 to about 3.5.

28. The process of claim 1 further comprising the step, after step (b) and either before or after step (c), of treating the nanoporous dielectric coating with a surface modification agent under conditions sufficient to render the nanoporous dielectric coating hydrophobic.

29. The process of claim 28 wherein the surface modification agent comprises hexamethyldisilazane.

30. The coated substrate formed by the process of claim 1.

31. A semiconductor device produced by a process which comprises:

(a) forming a substantially uniform alkoxysilane gel composition on a surface of a semiconductor substrate, which alkoxysilane gel composition comprises a combination of at least one alkoxysilane, an organic solvent composition, water, and an optional base catalyst;

(b) heating the semiconductor substrate for a sufficient time and at a sufficient temperature in an organic solvent vapor atmosphere to thereby condense the gel composition; and then

(c) curing the gel composition to form a nanoporous dielectric coating on the semiconductor substrate.